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DISTRIBUTION OF NUCLEAR FISSIONS CLOSE TO LARGE SHOWERS OF HEAVY PARTICLES

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A. P. Zhdanov first described the case of complete fission of a heavy nucleus under the action of very powerful particles contained in cosmic radiation[1]. Later, he described many different nuclear fissions occuring under the action of cosmic rays[2]. In a recently published work[3], he photographed a new case of fission in which a shower that consisted of 70-80 particles, flying for the most part in one direction, was formed. In this experiment, Zhdanov gave special attention to the simpler fissions accompanying the shower rather than to the nature of the shower itself. It developed that the number of such fissions very close to the shower was exceedingly high; on a 0.06-square-millimeter section of a plate, 16 fissions were found, which is approximately 4,500 times the number of fissions which take place for the same area under usual conditions. The number of fissions decreased quickly with increasing distances from the shower center; the fissions also occurred primarily in the direction of motion of the shower particles. This data prompts the assumption that a genetic connection exists between the shower and the simpler nuclear fissions.

In order to prove this assumption, a chart was compiled of the fissions found in a 1.44-square-millimeter area. This permitted a more detailed study of the angular distribution and the dependence of the number of fissions on the distance from the shower center. The fissions were divided into "stars," "showers," and solitary traces, and were also grouped according to the flight paths of the particles. In all cases, most fissions were found in the direction of flight of the particles of the main shower; particularly clear asymmetry of angular distribution was observed for fissions with the longest-flight particles and for showers. In studying the dependence of fission upon distance from shower center, a sharp decrease in the concentration of fissions in the direction of motion and of the main shower particles and a very weak decrease in the opposite direction was noted in all cases.

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The concentration of fissions in the direction of flight of the main shower particles and the sharp decrease in their number in proportion to distance from the center confirms the assumption that these fissions have a secondary derivation and do not emerge simultaneously with the shower under the action of a powerful narrow beam of cosmic particles. The fissions are produced by some sort of particles which are ejected together with particles of the shower itself, are not registered by photographic plates, and have an anomalous cross section of interaction. For these particles, Zhdanov evaluated the cross section (sigma) to be approximately equal to $10^{-21} - 6.10^{-23}$ square centimeters. Thus, most secondary fissions are "stars," which naturally suggests that the particles causing them are slow negative mesons (P. I. Lukirskiy and N. A. Perfilov showed recently that such mesons interact very effectively with nuclei, forming star-type fissions with only very weak pulses [4]) or varitrons (discovered by the Alikhanov brothers [5]). The asymmetry of angular distribution of the particles of the shower and the secondary fissions indicate that the energy of the cosmic particle generating the shower is approximately $10^{10} - 10^{11}$ eV.

Thus, Zhdanov showed that in the fission of nuclei by cosmic particles, there occurs not only a flight of different particles making up the nuclei, but also the formation of new particles of the varitron type.

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